

CLAIMS:

1. A method (10) for controlling multiple tasks in a system comprising:
provisioning (19) a Conditionally Guaranteed Budget Margin to a second task having an importance lower than a first task when said first task releases a Guaranteed Budget Margin; and
enabling (18) provision of the Conditionally Guaranteed Budget Margin by depletion of a More Important Guaranteed Budget in a current More Important Budget period and subsequent More Important Budget periods.
2. The method (10) according to claim 1, further comprising:
assigning (11) the first task to be a More Important Task.
3. The method (10) according to claim 1, further comprising:
assigning (12) the second task to be a Less Important Task.
4. The method (10) according to claim 2, further comprising:
allocating (13) a Guaranteed Budget Margin to the More Important Task along with a More Important Guaranteed Budget and explicitly informing the More Important Task of this allocation.
5. The method (10) according to claim 3, further comprising:
allocating (14) a Less Important Guaranteed Budget to the Less Important Task and explicitly informing the Less Important Task of this allocation.
6. The method (10) according to claim 5, further comprising:
allocating (14) conditionally the Conditionally Guaranteed Budget Margin to the Less Important Task and explicitly informing the Less Important Task of this allocation.
7. The method (10) according to claim 4, further comprising:
determining (16) that the More Important Task no longer requires its Guaranteed Budget Margin.

8. The method (10) according to claim 7, further comprising:
sending (17) a message that the More Important Task no longer requires its
Guaranteed Budget Margin.
9. The method (10) according to claim 8, further comprising:
allocating (19) the Conditionally Guaranteed Budget Margin to the Less Important
Task only if the More Important Guaranteed Budget is depleted.
10. The method (10) according to claim 9, further comprising:
determining (18) whether the More Important Guaranteed Budget is depleted.
11. The method (10) according to claim 9, further comprising:
determining (22e) that More Important Task does require its Guaranteed Budget
Margin.
12. The method (10) according to claim 11, further comprising:
sending (22f) a message that the More Important Task does require its Guaranteed
Budget Margin.
13. The method (10) according to claim 11, further comprising:
removing (22g) the Conditionally Guaranteed Budget Margin from the Less
Important Task and providing the Guaranteed Budget Margin to the More Important Task.
14. The method (10) according to claim 13, further comprising:
explicitly (22g) informing the Less Important Task of removal of the Conditionally
Guaranteed Budget Margin.
15. The method (10) according to claim 1, further comprising:
immediately (26) allocating the Guaranteed Budget Margin to the first task if the
More Important Guaranteed Budget is not depleted.

16. The method (10) according to claim 1, further comprising:

immediately (26) providing the Guaranteed Budget Margin to the first task if the Conditionally Guaranteed Budget Margin has not been allocated to the second task.

17. An apparatus (30) comprising:

a first task (34) having a first importance level;

a second task (35) having a second importance level lower than the first importance level;

an allocation mechanism (32) to allocate budgets of resources, said allocation mechanism (32) explicitly informing the first (34) task about a More Important Guaranteed Budget and a Guaranteed Budget Margin and explicitly informing the second task (35) about a Less Important Guaranteed Budget and a Conditionally Guaranteed Budget Margin; and

a scheduler (33) providing the budgeted amounts to the first and second tasks (34, 35), said scheduler (33) providing the More Important Guaranteed Budget plus the Guaranteed Budget Margin to the first task (34) at a first possible occasion and providing the Less Important Guaranteed Budget to the second task (35) at a first possible occasion, wherein upon the first task (34) determining at some point during execution that the first task (34) can execute properly with the More Important Guaranteed Budget only, said first task (34) explicitly informing the scheduler (33) that the first task (34) does not require its Guaranteed Budget Margin;

wherein the scheduler (33) stops providing the Guaranteed Budget Margin to the first task (34) at a first possible occasion;

wherein if the first task (34) has not depleted the More Important Guaranteed Budget the scheduler (33) does not provide the Conditionally Guaranteed Budget Margin to the second task (35) and if the first task (34) has depleted the More Important Guaranteed Budget then the scheduler (33) provides the Conditionally Guaranteed Budget Margin to the second task (35);

wherein upon providing the Conditionally Guaranteed Budget Margin to the second task (35) the scheduler (33) informs the second task (35) of the providing the Conditionally Guaranteed Budget Margin;

wherein the first task (34) determines at some point during execution that the first task (34) requires the Guaranteed Budget Margin as well and the first task (34) explicitly informs the scheduler (33) that the first task (34) does require its Guaranteed Budget Margin;

wherein the scheduler (33) immediately transfers the Guaranteed Budget Margin to the first task (34) if the Conditionally Guaranteed Budget Margin was not provided to the second task (35) because when the Guaranteed Budget Margin was previously released the More Important Guaranteed Budget Margin was not depleted; and

wherein the scheduler (33) informs the second task (35) that the Conditionally Guaranteed Budget Margin will be withdrawn if the Conditionally Guaranteed Budget Margin was provided to the second task (35) because when the Guaranteed Budget Margin was previously released the More Important Guaranteed Budget Margin was depleted, in which case the scheduler (33) stops providing the Conditionally Guaranteed Budget Margin to the second task (35) at a first possible occasion and the scheduler (33) starts providing the Guaranteed Budget Margin to the first task (34) at a first possible occasion.

18. The apparatus (30) according to claim 17, wherein depletion of the More Important Guaranteed Budget enables provision of the Conditionally Guaranteed Budget Margin in one or more subsequent More Important Guaranteed Budget periods.

19. An apparatus (40) comprising:

a first task (44) having a first importance level;

a second task (45) having a second importance level lower than the first importance level;

an allocation mechanism (42) to allocate budgets of resources, said first task (44) being explicitly informed about a More Important Guaranteed Budget and a Guaranteed Budget Margin and said second task (45) being explicitly informed about a Less Important Guaranteed Budget and a Conditionally Guaranteed Budget Margin;

a conditional budget monitor (46) to monitor an availability of the Conditionally Guaranteed Budget Margin, said conditional budget monitor (46) to receive a message that the More Important Task (44) no longer requires the Guaranteed Budget Margin, to receive a message that the More Important Task (44) now requires the Guaranteed Budget Margin,

to receive budget allocations of the Guaranteed Budget Margin, the Conditionally Guaranteed Budget Margin, the More Important Guaranteed Budget and the Less Important Guaranteed Budget from the allocation mechanism (42), and to send out a reservation command regarding the budget allocations; and

a scheduler (43) providing the budgeted amounts to the first and second tasks (44, 45) based on the reservation command, said scheduler (43) providing the More Important Guaranteed Budget plus the Guaranteed Budget Margin to the first task (44) at a first possible occasion and providing the Less Important Guaranteed Budget to the second task (45) at a first possible occasion, wherein upon the first task (44) determining at some point during execution that the first task (44) can execute properly with the More Important Guaranteed Budget only, said conditional budget monitor (46) sending a reservation command to the scheduler (43) including only the More Important Guaranteed Budget for the first task (44) and including the Conditionally Guaranteed Budget Margin along with the Less Important Guaranteed Budget for the second task (45) if the More Important Guaranteed Budget has been depleted but not if the More Important Guaranteed Budget Margin has not been depleted;

wherein upon the first task (44) subsequently determining that it now requires the Guaranteed Budget Margin, and communicating this to the conditional budget monitor (46), if when the Guaranteed Budget Margin was previously released by the first task (44) the More Important Guaranteed Budget had not been depleted and therefore the Conditionally Guaranteed Budget Margin had not been provided to the second task (45), the conditional budget monitor (46) immediately sending a reservation command to the scheduler (43) including the Guaranteed Budget Margin and the More Important Guaranteed Budget to the first task (44) and the Less Important Guaranteed Budget only to the second task (45); and

wherein upon the first task (44) subsequently determining that it now requires the Guaranteed Budget Margin, and communicating this to the conditional budget monitor (46), if when the Guaranteed Budget Margin was previously released by the first task (44) the More Important Guaranteed Budget had been depleted and therefore the Conditionally Guaranteed Budget Margin had been provided to the second task (45), the conditional budget monitor (46) sending a reservation command to the scheduler (43) including the Guaranteed Budget Margin and the More Important Guaranteed Budget to the first task

(44) and the Less Important Guaranteed Budget only to the second task (45), and the conditional budget monitor (43) informing the second task (45) of withdrawal of the Conditionally Guaranteed Budget Margin.

20. The apparatus (30) according to claim 19, wherein depletion of the More Important Guaranteed Budget enables provision of the Conditionally Guaranteed Budget Margin in one or more subsequent More Important Guaranteed Budget periods.

21. A method (500) for controlling multiple tasks in a system comprising:
accounting (508) a time a task remains blocked to a budget associated with the task;
and
maintaining (508) the budget with the blocked task during the period the task remains blocked.

22. The method (500) according to claim 21, further comprising:
sending (507) a message if either the first or second task becomes blocked
indicating a blocked status for the first or second task.

23. The method (500) according to claim 21, further comprising:
determining (509) if a blocking time exceeds a predetermined threshold.

24. The method (500) according to claim 23, further comprising:
implementing (510) budget withdrawal and reallocation technique of the blocking time exceeds the predetermined threshold.

25. The method (500) according to claim 23, further comprising:
continuing (508) to account the blocking time to the blocked task while the blocked task remains blocked or until a current budget expires.

26. An apparatus (30) comprising:
a task (34);

an allocation mechanism (32) to allocate a budget and a budget margin to the task;
and

a scheduler (33) providing the budgeted amount to the task (34), wherein upon the task (34) becoming blocked, the blocked task (34) sends a message to the scheduler (33) indicating a blocked status, wherein the scheduler (33) continues to provide the Budget and the Budget Margin to the blocked task (34) and accounts a blocking time to a budget of the blocked task until the blocked task (34) becomes unblocked or the budget period expires.

27. A method (600) for controlling multiple tasks in a system comprising:
providing (605) a gain time to a gain time consumer at a lower priority than a priority of a gain time producer; and
providing (605) the gain time to the gain time consumer at a higher priority than a priority of a next regular budget.

28. The method (600) according to claim 27, further comprising:
establishing (601) a first priority for a first task, said first task being the gain time producer;
establishing (602) a second priority for a second task, the second task being the gain time consumer, said second priority being lower than the first priority; and
establishing (603) an intermediate priority between the first and second priority, wherein said providing (605) the gain time to the gain time consumer further comprises providing the gain time to the second task at the intermediate priority.

29. An apparatus (70) comprising:
a first task (74) having a first priority execution level;
a second task (75) having a second priority execution level lower than the first priority level; and
a scheduler (73) determining gain time and allocating gain time among the first and second tasks, and allocating gain time from the first task to the second task at an intermediate level higher than the second priority level and lower than the first priority level and reallocating gain time back to the first task at the first priority level.

30. The apparatus (70) according to claim 29, wherein the scheduler provides gain time to a gain time consumer at a lower priority than a priority of a gain time producer and provides gain time to the gain time consumer at a higher priority than a priority of a next regular budget.

31. The apparatus (70) according to claim 30, wherein the scheduler establishes a first priority for a first task (74), said first task (74) being the gain time producer and establishes a second priority for a second task (75), the second task being the gain time consumer, said second priority being lower than the first priority, and establishes an intermediate priority between the first and second priority, wherein said providing the gain time to the gain time consumer further comprises providing the gain time to the second task at the intermediate priority.

32. A method (800) for controlling multiple tasks in a system comprising:
providing (805) a conditionally guaranteed budget to a less important task at a lower priority than a priority of a more important budget; and
providing (805) the conditionally guaranteed budget to the less important task at a priority immediately below a priority of the more important guaranteed budget being provided to the more important task.

33. The method according to claim 32, further comprising:
providing the conditionally guaranteed budget at the intermediate priority to the less important task but at a priority higher than a less important guaranteed budget being provided to the less important task.

34. The method according to claim 32, further comprising:
providing the conditionally guaranteed budget at the intermediate priority to the less important task but a priority lower than a less important guaranteed budget being provided to the less important task.

35. The method (800) according to claim 32, further comprising:
establishing (801) a first priority level for a budget of the higher important task;
and
establishing (803) an next priority level just below the first priority level, wherein
said providing (805) the conditionally guaranteed budget margin to the lower important
task further comprises providing the conditionally guaranteed budget margin to the lower
important task at the intermediate priority level.
36. The method according to claim 35, further comprising:
establishing (802) a second priority level for a budget of the less important task,
said second priority level being lower than the first priority level.
37. The method according to claim 35, further comprising:
establishing (802) a second priority level for a budget of the less important task,
said second priority level being higher than the first priority level.
38. The method (800) according to claim 32, further comprising:
determining (804) that the first task does not require the guaranteed budget margin
and then providing (805) the conditionally guaranteed budget to the less important task at
the intermediate priority.
39. The method (800) according to claim 38, further comprising:
determining (806) that the first task now requires the guaranteed budget margin;
and
returning (807) the guaranteed budget margin to the first task for consumption by
the first task at the first priority level.
40. An apparatus (90) comprising:
a first task (94) having a first priority execution level for consuming a first budget
and a guaranteed budget margin;
a second task (95) having a second priority execution level different than the first
priority level for consuming a second budget; and

a scheduler (93) providing the guaranteed budget margin to the first task at the first priority level and providing a conditionally guaranteed budget margin to the second task at an intermediate level immediate below the first priority level.

41. The apparatus according to claim 40, wherein the second priority level is lower than the first priority level.

42. The apparatus according to claim 40, wherein the second priority level is higher than the first priority level.